MULTI-POINT, ONE-PIECE SEAT BELT

CROSS REFERENCE TO RELATED APPLICATIONS

This is a continuation-in-part application of co-pending international application number PCT/DE98/03270 (WO 99/24294) filed Nov. 10, 1998 and claiming the priority of DE 197 49 780 A1 filed Nov. 11, 1997 is revised and refiled.

BACKGROUND OF THE INVENTION

1. Field of the Invention:

It is an object of the present invention to improve the restraint of a passenger in order to lower all acceleration-dependant loads

- in the event of any accident (front-, side-, rear-end collision and/or rollover or pile up/mass collision) of a motor vehicle, in particular, a car, school-bus, bus or truck, of train (commuter train) or of an aeroplane or
- during turbulence-related vibration of an aeroplane

thus enhancing survival chance.

2. Discussion of the Prior Art:

It is known in the prior art to provide

- a three-point seat belt (safety belt or lap-shoulder seat belt assembly), mounted in a motor vehicle, consisting of a shoulder belt extending across the upper part of body and of a lap belt extending across the lower part of body;
- a two-point seat belt, mounted in aeroplane, acting as lap belt extending across the lower part of body or
- a suspender- (waist-) belt consisting of several pieces (belt-members).

It is well known to provide different restraint systems in vehicles, predominantly, three-point seat belts in various types for seats, exemplified by DE 37 41 831 A1 shown in **Fig.** 11. Evidently, when both shoulders of a passenger, conventionally belted, are not restrained in the event of an arbitrary collision with another vehicle in any direction, shown in **Figs.** 3, 4 and 7, the unrestrained shoulder can always move and/or rotate freely, thereby resulting in severe/fatal injuries in a number of accidents when

- the head crashes against the steering wheel and/or window pane and/or
- the airbag crushes the head, which, loaded by the forces related to pitch-acceleration $\ddot{U}_H$, yaw-acceleration Ö, longitudinal and/or lateral acceleration, is in "oop" (out of position).

Moreover, by the definition of „submarining" the belted passenger submarines (slips downward) under his seat belt thus negating the protective effect of the seat belt.

It is well known to provide a two-point or lap seat belts for aeroplane seats as well as mid-portion of the rear seat of the vehicle. This lap seat belt is far less effective than a three-point seat belt. Due to very large accelerations during a turbulence-related flight the protective effect is very low.

A substantially improved protection is proposed by two different configurations of a one-piece seat belt, exemplified by DE 26 02 875 A1 (**Figs.** 8 to 10). An „X-shaped" restraint is arranged by extending both shoulder belts crosswise over the upper part of body while the lower part of body is restrained by the lap belt. Each end of the one-piece seat belt is connected to a belt retractor, fastened in the seat backrest. Two grab rings, positioned to the headrest, move along the belt. A single or double „X-shaped" configuration is defined by pulling a pair of grab rings and belt portions over the head, shoulders and head rest and

engaging them in the corresponding hooks. Due to such intricate operation the seat belt remains unused.

According to US 3,977,696, US 5,123,673, US 5,411,319, DE-OS 23 45 847, DE-OS 28 13 888 and DE 196 29 878 A1 the restraint system comprises a three-point seat belt, a second shoulder belt and two belt retractors, responsible for retracting both belts. The „X-shaped" configuration, formed by extending both belts crosswise over the upper part of the body, has the following drawbacks in the event of an accident:

I. Both belts are retracted to different length by two independently operating belt retractors within milliseconds.

II. Under the load of the same belt force in a front collision the deformation of seat backrest, wherein both belt ends are fastened, is larger, thus increasing the forward motion. Furthermore, it is impossible to attach an energy absorber because all four belt ends are occupied.

A one-piece seat belt **1** (**Fig.** 1) ref. to DE-OS 28 13 888 is equipped with two belt retractors (not drawn), fastened to both belt ends in the seat backrest, and a belt deflector **17**, anchored to the seat frame **3.3** of the mid-portion of rear seat. The feature has the following drawbacks:

- When the release button **84** is pressed, the belt portion **1.1** gets entangled around the neck of passenger. For the operation of restraining and extending both belt portions into the „X-shaped" configuration, the passenger must lower his head first.
- Because all belt ends are occupied, it is impossible to attach an energy absorber and to adjust the belt to the height of the upper part of body **95**.

Generally, a child-seat is fastened by four auxiliary belts to the seat. Despite the „X-shaped" configuration of a one-piece seat belt to restrain a child, sitting in a child-seat, ref. to FR 2 342 872 A1 the problems, associated with the retraction of four auxiliary belts, submarining and energy absorption, remain unsolved in an accident.

Till now, trains, school buses and buses are not provided with restraint systems.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a one-piece seat belt with a single belt retractor, solely responsible for the retraction or protraction, a belt deflector to loosely guide a belt portion and multi-attachment points,

- to enhance the convenience and comfort of the passenger and
- to restrain the passenger in multi-attachment points (multi-points of restraint), in order to distribute the acceleration-dependent loads, shown in **Fig.** 3 and **Tables** 1 to 3, to the multi-attachment points in the event of any collision of a vehicle, train or aeroplane or any turbulence-related vibration of an aeroplane.

This principle and other objects of the present invention are accomplished by the following features (proposals):

- user-friendly belt-feeding device to ease the restraint and
- integration of the multi-point seat belt **1, 1a to 1d**, equipped with energy absorbers and the seat **3, 3a to 3d**, into a baby-cot, child-seat or safety seat, illustrated in **Figs.** 1, 23.

in order to control all acceleration rates and loads below the respective injury-related values during the arbitrary real collision, thus ensuring the restraint function and saving life.

Summary of the advantages of the present invention in real accident:

- The survival chance is enhanced by the restraint of
  - * both shoulders and the torso, when the passenger is thrown forward (**Fig. 4**, **Table 3**) and/or subjected to the yaw Ö-acceleration-dependent torque $T_{ö}$, and
  - * both thighs and the lower part of the body, when the passenger submarines.
- Because the belt retractor is attached to one belt end, a number of sets of energy absorbers ref. to WO 99/24292 (PCT/DE98/03271, DE 197 58 498 A1) or DE 197 58 497 A1 can be attached to the other belt end (**Figs.** 12a, 12b, 18), thus gradually absorbing large impact energy below the respective injury-related values. Both applications are issued by to the inventor of the present application. The energy absorber consists of a number of clamping elements, having sites of predetermined fracture, and a retaining element, fastened to the seat backrest frame, seat frame or serving as an integral part thereof.
- Owing to the different positions of buckle assemblies, in plug-in connection with the respective latch plates, passengers of different body proportions can adjust the belts by themselves. Moreover, seats, equipped therewith, for adults can be modified for the children and vice versa, thus augmenting the rate of seat occupancy in a bus, train or an aeroplane, exemplified in **Fig.** 23.
- In another embodiment the latch plate **5b** (**Fig.** 15), in plug-in connection with the buckle assembly, or the buckle assembly is height-adjustable. Energy absorbers ref. to DE 197 58 497 A1 can be connected to this buckle assembly. Upon the use of the height-adjustable latch plate **5b** the height-adjustable D-ring **12**, attached to the B-, C-, D-post section (pillar, pillar portion), shown in **Fig.** 1, or to the top edge of the seat backrest, is no longer needed.
- In another embodiment the belt deflector **5a** (**Fig.** 13) can be rigidly attached to the head rest **3.6a**. Any adjustment of the height of the head rest **3.6a** to the head automatically adjusts the height of the belt deflector to the shoulder. This feature differs from the D-ring ref. to DE 40 10 452 A1, which is in contact with the shoulder belt, when the passenger is thrown forward, and is moved up to intercept the head, when thrown backward.
- In resting position the latch plate **2**, in plug-in connection with the side buckle assembly **16, 16a, 16b** fastened to the seat cushion **3.1**, B-, C-post section or seat backrest (**Figs.** 1, 2), is easily accessed by the passenger for the purpose to belt.
- The seat belt can be equipped with a belt-feeding device, manually operated or by a drive apparatus e.g. hydraulic-piston cylinder unit, electrical motor (not drawn), which enhances the convenience and comfort of the user. This drive apparatus is switched on by a pressure sensor, built to the seat, or an existing switch such as lighting-, door- or touching switch. If the belt is not engaged within a dwell time, a control device is activated to switch-off the drive apparatus and to reposition the belt-feeding device in resting position.
- For the convenience of the passenger or a quick-rescue of the passenger in case of an emergency and/or accident the master release button **84** of the buckle assembly **9.1** is pressed to release all latch plates from the buckle assemblies.
- The round rollover tubes **20.2b** of the seat backrest frame **3.4d** are designed to guide the belt housing **20.4c, 20.4d** (**Figs.** 18, 19) and in rollover to act as safety bars, having openings **97R, 97L** (**Fig.** 23) to allow free view to the rear.
- In another embodiment the seat belt can be connected to the seat in more than three attachment-points (**Figs.** 1, 14, 23), in which both thighs (femurs) are restrained, thus protecting the passenger against submarining in front, rear collision or rollover or when in sleeping position. Unlike the suspender- (waist-) belt, consisting of several belts, the portions of multi-point seat belt need not be adjusted in length, when the circumference of the passenger varies depending on the clothes worn.

BRIEF DESCRIPTION OF THE DRAWINGS

A number of embodiments, other advantages and features of the present invention will be described in the accompanying tables and drawings with reference to the xyz global coordinate system:

Table 1 shows test data such as left / right thigh-force, belt force and pitch-angle of driver and co-driver in 50% offset crash test of several European vehicles [2].

Table 2 shows yaw angle O of driver / co-driver in 50% offset crash tests [3].

Table 3 shows test data of the safest child-restraint system Chico Shuttle® at the converted velocity of 55 km/h in comparison with the safest vehicle [4].

Fig. 1 is a perspective view of a seat with buckle assemblies attached to the seat backrest and seat cushion as well as of the 1st embodiment of restraint system consisting of a multi-point seat belt **1**, latch plate **11** along the lap belt, latch plate **2** of belt end, in the direction of arrow „Z" in plug-in connection with a buckle assembly **4**, and a seat belt in X-shape, formed by crossing both shoulder belt portions **1.1, 1.2**.

Fig. 2 is a perspective view of a seat and of the 2nd embodiment of a restraint system comprising three-point seat belt **1e** having a latch plate **2**, which will be inserted into a buckle assembly **4e** of a shoulder belt **1.11**, pulled in the direction of arrow „Z".

Fig. 3 illustrates load cases I, II and III in z-y plane in the event of arbitrary real collision.

Fig. 4 is a perspective view of a restrained dummy thrown forward in VW Polo® in 50% offset crash test.

Fig. 5 illustrates a yaw-acceleration Ö and yaw-angle O of a vehicle about the vertical axis „z_A" in 50% offset crash test of two identical vehicles [5].

Fig. 6 illustrates a yaw angle O of vehicle about the vertical axis „z_A" in 50% offset crash test against a stiff barrier.

Fig. 7 illustrates four collision types U1 to U4 [1].

Fig. 8 is a front view of a seat belt ref. to DE-OS 26 02 875 in home position.

Fig. 9 is a front view of a double X-shaped seat belt ref. to DE-OS 26 02 875.

Fig. 10 is a front view of a single X-shaped seat belt ref. to DE-OS 26 02 875.

Fig. 11 is a top view of a ∠- shaped seat belt ref. to DE 37 41 831 A1.

Fig. 12a is a schematic, perspective view of the 1st embodiment of a buckle assembly **4a**, equipped with release cable **4.2**.

Fig. 12b is a schematic, perspective view of the 2nd embodiment of a buckle assembly **4b**, equipped with an electrical motor **4.2b**.

Fig. 13 is a perspective view of a belt deflector of the head rest.

Fig. 14 is a perspective view of a latch plate **11** of a lap belt portion **1.3** in plug-in connection with a buckle assembly **8** and of the 1st embodiment of a belt-feeding device **20** of the seat belt.

Fig. 15 is a perspective view of the 2nd embodiment of a spatially-adjusting belt-feeding device **20a** from the resting position to the operating position and of a height-adjustable belt deflector **5b**.

Fig. 16 is a schematic view of the 2nd and 3rd embodiment of spatially-adjusting belt-feeding devices **20a** and **20b** in kinematics from the operating position to the resting position in x-y plane.

Figs. 17a to 17f are schematic, perspective views of the belt-feeding device **20** in kinematics from the resting position to the operating position.

Fig. 18 is a schematic, perspective view of a seat, equipped with the rollover tubes **20.2b**, and of the 4th embodiment of a belt-feeding device **20c**.

Fig. 19 is a schematic, perspective view of a seat having the rollover tubes **20.2b**, the 5th embodiment of a belt-feeding device **20d**, provided with a safety bracket **20.6**, a height- and width-adjusting mechanism **27, 27a**.

Fig. 20 is a cross-sectional view of the 1st embodiment of the height- and width-adjusting mechanism **27** along the line I-I of **Fig.** 19.

Fig. 21 is a cross-sectional view of the height- and width-adjusting mechanism **27** along the line II-II of **Fig.** 20.

Fig. 22 cross-sectional view of the 2nd embodiment of the height- and width-adjusting mechanism **27a** along the line I-I of **Fig.** 19.

Fig. 23 is a front view of the seat **3a to 3d**, in which the restraint systems **1a to 1d** are integrated, for passengers of different weights and body proportions (sizes).

DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

The advantages of the preferred embodiments, above-mentioned in the Chap. "Summary of the advantages...", are outlined hereinafter with regard to the functions and features thereof.

The method of the present invention capitalizes on the premise that a one-piece seat belt is employed to restrain a passenger in at least four attachment points of the seat to distribute the loads thereto and sustain the yaw Ö-acceleration-dependent torque $T_{ö}$ in an accident, thus ensuring the operation of a single belt retractor to pre-tension (bias) as well as tension the belt, restraining both shoulders, upper- and lower part of the body and lowering loads, in particular, in co-operation with the energy-absorption when a number of sets of energy absorbers is put into use. This will be apparent by formulating all forces, imposed on the belted passenger, shown in **Figs.** 3 and 4, in the event of a front collision, where the loads of the mass D_S of the torso are lowered because

- the forward motion „w_v" is minimized, thus substantially reducing the pitch-acceleration $Ü_H$ and force F_{Hy} of the mass D_H of the head, and
- the yaw-acceleration Ö is minimized, thus substantially reducing the torque $T_{ö}$, imposed on the head. The torque $T_{ö}$ is the most latent force, responsible for fatality.

Hence, massive head injuries related to [6 to 9] can be avoided.

Load case I in z-y plane: The rotating mass D_S rotates about the rotating axis „S" at the pitch-angle U_S and mass D_H about the rotating axis „z" at the pitch-angle U_H in **Table** 1, thereby resulting in the pitch-accelerations $Ü_S$, $Ü_H$ and rotating forces F_{Sy}, F_{Hy}. The addition of both rotating forces yields the force F_V of forward motion w_V of passenger, shown in **Fig.** 4. In front- and/or rear collision the passenger is exposed to the submarining force S_y, shown in **Fig.** 14.

Load case II in x-y plane: The upper part of body is subjected to the torque $T_{ö}$, exerted by the yaw-acceleration Ö about the rotating axis „z".

Load case III in x-z plane: The rotating mass D_S rotates about the rotating axis „S" at the rotating angle U_y and mass D_H about the rotating axis „z" at the rotating angle U_{Hy}, thereby resulting in the rotating accelerations $Ü_y$, $Ü_{Hy}$ and rotating forces D_{Sy}, D_{Hy} (not drawn). In rollover the passenger is subjected to the load F_{Sz}.

Load case IV: In turbulence-related vibration of an aeroplane the load D_{Sy} together with D_{Hy} takes the form of periodical load $\pm F_{Hx}$, F_{Sz} of $\pm F_{Sz}$, $T_{ö}$ of $\pm T_{ö}$, S_y of $\pm S_y$ and F_{Sy} together with F_{Hy} of $\pm F_V$.

The restraint system, illustrated in **Fig.** 1, is provided with the conventional belt retractor **13**, whereto the belt end EL is connected, and a clamping device, both pieces are arranged in the B-, C-, D-post section or in one of both sides SL and SR of a seat backrest **3.2** or to the floor **6**.

The other belt end ER is provided with a latch plate **2**, which is retained, loosely guided by a belt deflector **17**, fastened to the floor **6**, side rail or seat frame. This belt deflector **17** replaces the conventional fitting, fastened to the side rail, to receive to the belt end of the three-point seat belt. The latch plate **2** is plug-in connected to one of the buckle assemblies **4, 4b, 4c, 14, 14a, 18, 18a, 18b**, arranged in or to the seat backrest **3.2**. However, in another embodiment, described hereinafter, the other belt end ER is secured in the side SR of a seat backrest, shown in **Figs.** 18, 19.

In all embodiments an additional latch plate **9** can move along the seat belt **1** between both belt ends EL and ER. When plug-in connecting the latch plate **2** (in the direction of arrow „Z") to the buckle assembly **4** and the latch plate **9** to the buckle assembly **9.1**, the X-shaped restraint of the upper part of body and both shoulders are achieved by both belt portions **1.1, 1.2** and the restraint of the lower part of body is achieved by the lap belt portion **1.3**.

In various embodiments the X-shaped restraint of the upper part of body can be achieved by both belt portions upon plug-in connection of

- a *number* of latch plates **2, 9, 11, 25** with the respective buckle assemblies **4, 4a to 4c, 4e, 7, 8, 8a to 8d, 9.1, 14, 14a, 15, 15a, 18, 18a, 18b, 18.1 to 18.3, 19, 19a, 19b, 19.1 to 19.3** (**Figs.** 1, 14, 19, 23), thus increasing the multi-attachment points, which can be provided with sets of energy absorbers ref. to DE 197 58 497 A1 as well as WO 99/24292 for the purpose of increasing the distribution and absorption of great energy; *or*
- a *single* latch plate **9** with buckle assembly **9.1** upon the use of the belt-feeding device **20**, where the belt end ER is connected to the seat backrest frame or the sets of energy absorbers (**Figs.** 18, 19), for the enhanced comfort of the sitting passenger (**Figs.** 14, 17a to 17f), maintaining the common practise to operate the conventional three-point seat belt and enforcing the passenger to use a seat belt. However, the distribution of loads to the multi-attachment points can be increased by additional plug-in connection of the latch plates **11, 25** with the respective buckle assemblies, shown in **Fig.** 23.

As shown in **Figs.** 1 and 14, the seat belt **1** is equipped with a third latch plate **11**, which can be connected to one of the buckle assemblies **7, 8, 8a to 8d**, arranged in or to the seat frame **3.3**. When plug-in connected, the lap belt portion **1.3** is subdivided into two belt portions **1.3R, 1.3L**. Owing to the restraint of both thighs the submarining problem in front- or rear collision, in rollover or turbulence-related vibration of an aeroplane is resolved. Moreover, the passenger, lying in a sleeping position ref. to DE 37 41 831 A1 (**Fig.** 11), is well protected.

Because the reel (spool) of the conventional belt retractor can accommodate only a limited length of belt, it is possible that the length of the seat belt for the sleeping position is insufficient. As exemplified in **Fig.** 1, a buckle assembly **8b, 8c** is provided with a release button **84e** and a length-adjustable belt, fastened to the seat frame, for the purpose of compensating the length of seat belt **1** between the sleeping and normal position.

A buckle assembly **8d**, provided with a release button **84d**, is attached to the front portion of the seat cushion.

Owing to the plug-in connection of latch plates **11, 25** with the respective buckle assemblies a lady in a long gown as well as a child are well protected from submarining (**Fig.** 23).

The belt deflector **17** comprises a housing having an attachment hole to receive a bolt **17.1**. Both parts can be made in one piece. If necessary, the bolt **17.1** is surrounded by a sleeve **17.2** of plastics, having corrugation or knobs, which is a common part of the conventional D-ring **12**. This D-ring **12** is suitable too for the belt deflector **17**. The aperture of the belt deflector **17** to loosely guide the belt portion is dimensioned to that size to retain the latch plate **2** in resting position, thus allowing the use as a three-point seat belt.

In the 1st embodiment ref. to **Figs.** 14, 17a, 17d the belt-feeding device **20** in resting position is provided with a device to countersink the belt-feeding plate **20.9** in the seat backrest to improve the overall impression of the seat-design, whereon the sales success depends.

When the passenger takes his seat, a drive apparatus is activated to

- move up the belt-feeding plate **20.9** (**Fig.** 17a), and then the guide tube **20.1** with the operating arm **20.2**, whose end has a belt ring **20.8** to loosely guide the belt portion **1.1** (**Fig.** 17b);
- rotate those parts in front of the upper part of the body **95** at „β" (**Fig.** 14), where the pin of the operating arm projects through the hole of the belt-feeding plate **20.9** or a clamping hole **20.11** of the belt-feeding plate **20.9a** (**Figs.** 17c, e, f); and
- countersink all parts **20.1, 20.2, 20.9** or **20.9a** in the seat backrest (**Fig.** 17d) to restrain the upper part of the body and both shoulders in the „X-shape" of both shoulder belt portions.

To prevent the entanglement of the belt portion **1.1** behind the seat, particularly when positioned furthest forward, that belt portion **1.1** in resting position is intercepted by the belt-catching element **20.7, 20.7a** (**Figs.** 14, 17a, 17b).

When the seat **3c** (**Fig.** 23) has a high seat backrest, the curved guide tube **20.1** of belt-feeding devices **20a** (**Fig.** 15) can be modified in a straight-running operating arm **20.2** of the belt-feeding device **20**.

In the 2nd or 3rd embodiment the belt-feeding device **20a** or **20b** is provided with a height-adjustable belt housing **20.4a** and radial-adjustable tube **20.3** (**Figs.** 15, 16). Both devices differ from each other by the position of the guide tubes **20.1** on the seat backrest. Each guide tube can be driven by a drive apparatus, housed in the seat backrest. The guide tube **20.1** of the belt-feeding device **20a** is pivotally attached in a stiff supporting tube **3.61** of the height-adjustable head rest **3.6a**.

Adjustable is the height of „Δh" of

- the belt housing **20.4a**, having a latch plate **2**, plug-in connected to any buckle assembly **4, 14, 18**, by moving two openings, facing each other, along the operating arm **20.2a**, and
- the belt deflector **5b** by moving a handle **5.2**, such as locking handle **27.5** of the height- and width-adjusting mechanism **27, 27a** (**Figs.** 15, 19 to 22).

The belt-feeding devices **20a, 20b** should meet the following criteria:

- it should be possible to freely get in and out of the vehicle compartment thanks to the distances of „a" and „b" between the post section **91** and operating arm **20.2a** (**Fig.** 16) in resting position;
- there should be no contact with the head rest **3.6a**, height-adjustable about „Δh_K", and with the head of the passenger with/without hat **92**.

Regarding the kinematics of the height-adjustable belt housing **20.4a** with the latch plate **2** from the operating position to the resting position, the trajectories of „Ba2" and „Bb" are not in the range of a hat thanks to a radial-adjustable tube **20.3** incorporated into the operating

arm **20.2a**. Without the radial-adjustable tube **20.3** the operating arm in the trajectory of „Ba1" interferes with that hat.

In the 4th and 5th embodiment ref. to **Figs.** 18, 19 the belt-feeding devices **20c, 20d** differ from each other by the rotatory movement of the operating arm **20.2**, whose guide tube **20.1** is pivotally attached to a bearing casing **20.10**. Preferably, upon the rotation about the head, the translatory and rotatory movement of belt are synchronized.
To form the upper part of the seat backrest frame **3.4d** a pair of angle fittings **26a**, a pair of rollover tubes **20.2b** and a pair of side girders **27.1a** or four tubes **27.1** (not drawn) are form- and/or force-locking connected to each other by connecting pins **26.2, 26.3** (drawn with dotted lines) and/or by welding, bolting, glueing and/or riveting. The belt housing **20.4c** or **20.4d**, having a moveable safety bracket **20.6**, is guided by rollover tubes **20.2b** and driven by an electrical motor **20.5** along the threaded spindle **20.1a**, fastened to both angle fittings **26a**, from the resting position (drawn with dotted lines) to the operating position, and back again. In the operating position the holes of the rollover tube **20.2b** and belt housing **20.4d** are aligned with each other, thus permitting the legs of the safety bracket **20.6**, loaded in the event of rollover of a convertible, roadster or sport-utility vehicle, to project therethrough and clamp the shoulder belt portion **1.1**.

Upon plug-in connection of the latch plate **2** with the buckle assembly **4, 4a, 4b** the belt end ER of belt portion **1.1** is connected to the coupling part **1.2a, 1.2b** (**Figs.** 12a, 12b), whereto a number of energy absorbers is attached to absorb energy. In a cost-saving embodiment without the latch plate **2** and buckle assembly, the belt end ER of belt portion **1.1** is directly connected to the coupling part **1.2a** or **1.2b** (**Fig.** 18) to receive energy absorbers, the retaining elements of which are fastened to the seat backrest frame **3.4d**. In order to absorb great energy in the event turbulence-related vibrations of an aeroplane or accident of a fast speeding car or high-speed train, the belt retractor **13**, coupling part **1.2b** of which is connected to energy absorbers, is moveable attached to the oblong holes of a stiff plate **13.3**, fastened to the seat backrest frame in the side SR so that the other belt end EL can be exploited to receive additional energy absorbers, as proposed by the inventor of the present application in the applications DE 197 58 497 A1 and WO 99/24292. In excess of threshold value the belt retractor pulls the clamping elements along the respective retaining elements to absorb energy and damp vibration.

In the 1st and 2nd embodiment (**Figs.** 12, 21) the buckle assembly **4a, 4b, 4c** is form- and/or force-locking connected to the seat backrest frame.

For the convenience of the passenger to egress from the vehicle and in cases of emergency the following embodiments of disengagement are proposed:
To disconnect the latch plates **2, 11** and/or **25** from the buckle assemblies **14, 14a, 15, 15a** (**Fig.** 1) and buckle assemblies **18, 18a, 18b, 18.1 to 18.3, 19, 19a, 19b, 19.1 to 19.3** (**Fig.** 23) of the seat arrangement, particularly for children, as well as from the buckle assemblies **7, 8, 8a to 8d** (**Figs.** 1, 14), the master release button **84** is pressed, thus activating the release wires **4.2** and/or electrical motors **4.2b**, which pull the release button **84a** and/or **84b** of the buckle assemblies (**Figs.** 12a, 12b, 21).
When depressing the master release button **84** the drive apparatus of the belt-feeding device **20, 20a to 20d** returns the shoulder belt portion **1.1** from the operating position to the resting position.

According to the traffic- or flight law during the travel or turbulence-related flight passengers must remain belted. The need for a partial unrestrainedness of a belted passenger becomes apparent, when this passenger must take care of his (her) frightened children seating on the rear seat. The separately operated release button **84o, 84d**, when depressed, disengages only the latch plates **11, 25** of the lap belt portion from the assemblies **7, 8, 8a, 8d** (**Figs.** 1, 23) to annul the protection from submarining.

In the 1st embodiment (**Figs.** 19 to 21) the height- and width-adjusting mechanism **27** comprises a frame **29**, buckle assembly **18.3, 19.3**, a pair of tubes **27.4**, parts **27.5 to 27.9** and a pair of tubes **27.1** having a plurality of locking slots, in form- and force-locking connection with an angle fitting **26a**. The frame **29** consists of a pair of outer tubes **27.3**, a pair of tubes **27.2** and a connecting part of all tubes. The locking handle **27.5** is form- and force-locking connected to the slots of the inner tubes **27.4**.
These inner tubes **27.4**, inserted into the outer tubes **27.3**, are pre-loaded by the springs **27.6**. Each spring **27.6** on a sleeve **27.7**, secured by pin **27.8**, protruding through the holes of the inner tube **27.4**, presses against the spring rest **27.9** of the outer tube **27.3**.
The locking handle **27.5** is in engagement with a pair of locking slots of tubes **27.1**. The pulling of the locking handle **27.5** out from both slots results in disengagement, thus enabling the adjustment of the height of mechanism **27** and buckle assembly.
The outer tube **27.3** is provided with a plurality of locking slots q, r, s etc., drawn with dotted lines. in **Figs.** 20, 22.
After the pawl **18.10**, pre-loaded by the spring **18.5**, is disengaged from the locking slot r by its movement in the direction of arrow (**Fig.** 21), the housing **18.12**, form-locking connected to the buckle assembly **4c**, can be moved along both outer tubes **27.3**.
The belt portion **1.1, 1.2**, loosely guided by a U-shaped latch plate **25** (**Figs.** 19, 22), is loosely locked by the quick-release pin **25.1**.

For juxtaposed seats in vehicles, buses, trains and aeroplanes it is recommended to use a single locking handle **27.5** to operate the 2nd embodiment of the height- and width-adjusting mechanism **27a** of each seat **3c** having e.g. three pairs of openings **18.1 /19.1 to 18.3 / 19.3** to receive a pair of latch plates (**Figs.** 22, 23).
The frame **29a** consists of two pairs of outer tubes **27.3**, two pairs of tubes **27.2**, a pair of connecting parts of all tubes and parts **18.3, 19.3, 27.6 to 27.9a, 27.11**, attached to the outer tubes **27.3**.
The locking handle **27.5** is form- and force-locking connected to slots of the inner tubes **27.4** by the pins **27.12**. After inserting these inner tubes into the outer tubes **27.3** the locking plate **27.10** is form- and force-locking connected to the slots of the inner tubes and to the pins **27.12**.
After securing the spring rest **27.9a** by the retaining rings **27.11**, both sleeves **27.7a** by the pins **27.8**, protruding through the holes of inner tubes **27.4** and oblong holes of outer tubes **27.3**, the inner tubes with locking handle **27.5** are pre-loaded by springs **27.6**. By pulling the locking handle **27.5** out from both slots, the disengagement takes place, thus enabling the adjustment of the height of mechanism **27a**.
After pulling and disengaging the locking handle **27.5** from both slots, the height of height- and width-adjusting mechanism **27a** can be adjusted.

Although the present invention has been described and illustrated in detail, it is clearly understood that the terminology used is intended to describe rather than limit. Many more objects, embodiments, features and variations of the present invention are possible in light of the above-mentioned teachings. Therefore, within the spirit and scope of the appended claims, the present invention may be practised otherwise than as specifically described and illustrated.